CHANNEL UNITS

END-TO-END TRANSMISSION TESTS

This Section provides procedures for performing end-to-end transmission tests on D448 channel units.

This Section has been reissued to clarify ATAU test procedures and add information on ETS-4 testing.

WARNING: This equipment contains static-sensitive (CMOS) devices. Section ITTR-18-599 contains handling instructions for CMOS-equipped units.

The procedures in this Section should be performed after options have been selected on the channel units and the channel units have been installed in the multiplex shelf. Refer to Section ITTR-18-440 and/or ITTR-18-441 for option selection and installation procedures for the channel units.

The recommended method of testing, using the automated test and alignment unit (ATAU), 628450, is presented in Chart 1. If an ATAU is unavailable, the tests may be performed using standard test equipment, as described in Chart 2.

Since the tests outlined in Section ITTR-18-443 (single-ended transmission testing) satisfy most local practices, performance of the tests contained in this Section is not required either for initial lineup or channel reassignment; however, any or all of the tests may be performed optionally.

Channel unit transmit and receive voice frequency (VF) levels are set at the factory prior to shipment. If the office wiring loss (OWL) and nominal levels are known, the prescription level adjustments make level testing optional. The channel units are shipped with the nominal transmit and receive VF levels given in Table A.

TABLE A

FACTORY-SET CHANNEL UNIT LEVELS

CHANNEL UNIT TYPE	TRANSMIT LEVEL	RECEIVE LEVEL
2-Wire	0.0 ±0.25 dBm	−3.0 ±0.25 dBm
4-Wire	−16.0 ±0.25 dBm	+7.0 ±0.25 dBm

If the far-end terminal is an ITT T324 (or equivalent without prescription level adjustments) and has not been previously adjusted, the end-to-end level test should be performed.

If trouble occurs while performing any of these tests, refer to the appropriate Section listed in Table B for trouble location procedures.

TABLE B

TROUBLE LOCATION PROCEDURES

TITLE	SECTION NO.
Mode 1 Alarm Trouble Location	ITTR-18-531
Mode 2 Alarm Trouble Location	ITTR-18-532
Mode 3 Alarm Trouble Location	ITTR-18-533
Non-Alarm Transmission and Signaling Trouble Location	ITTR-18-543

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1—End-to-End Testing Using the ATAU	2
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CHART 1

END-TO-END TESTING USING THE ATAU

APPARATUS (REQUIRED AT EACH END):

1—ATAU, 628450

1—Card jack/310 adapter cord (ITT Part No. 600397-540-003) (used in crosstalk test only)

STEP	PROCEDURE
	TEST SETUP
	Note: If an ATAU is not being used at one of the offices, refer to Chart 2 for procedures using standard test equipment at that office.
1	At both terminals, plug ATAU power cord into socket on bottom of case. Plug other end of power cord into a commercial 115-Vac outlet.
2	At both terminals, place POWER switch in on position.
	Note: Various LEDs and the readouts will flash for several seconds following application of power to the ATAU. This is normal and indicates that the ATAU is going through a self-test. If any TEST SELECT LED remains flashing after the ATAU self test is complete, the associated TEST SELECT button should not be pressed. You may use all other test functions on the ATAU. At your earliest convenience, return the ATAU to ITT for repair (refer to Section ITTR-18-599).
3	At both terminals, select END-END button.
4	Designate near-end terminal as transmitting terminal and far-end terminal as receiving terminal.
5	At both terminals, make required test connection between ATAU and channel unit under test (CUUT) (Fig. 1).
	Note: ETS-4 channel unit has two splitting card jacks. The lower jack, J2, must be used for VF and RX SIG access by the ATAU.
6	At both terminals, press TERMINATION button corresponding to CUUT type and impedance.
7	At transmitting terminal, set TX LEVEL thumbwheel switches to desired level.

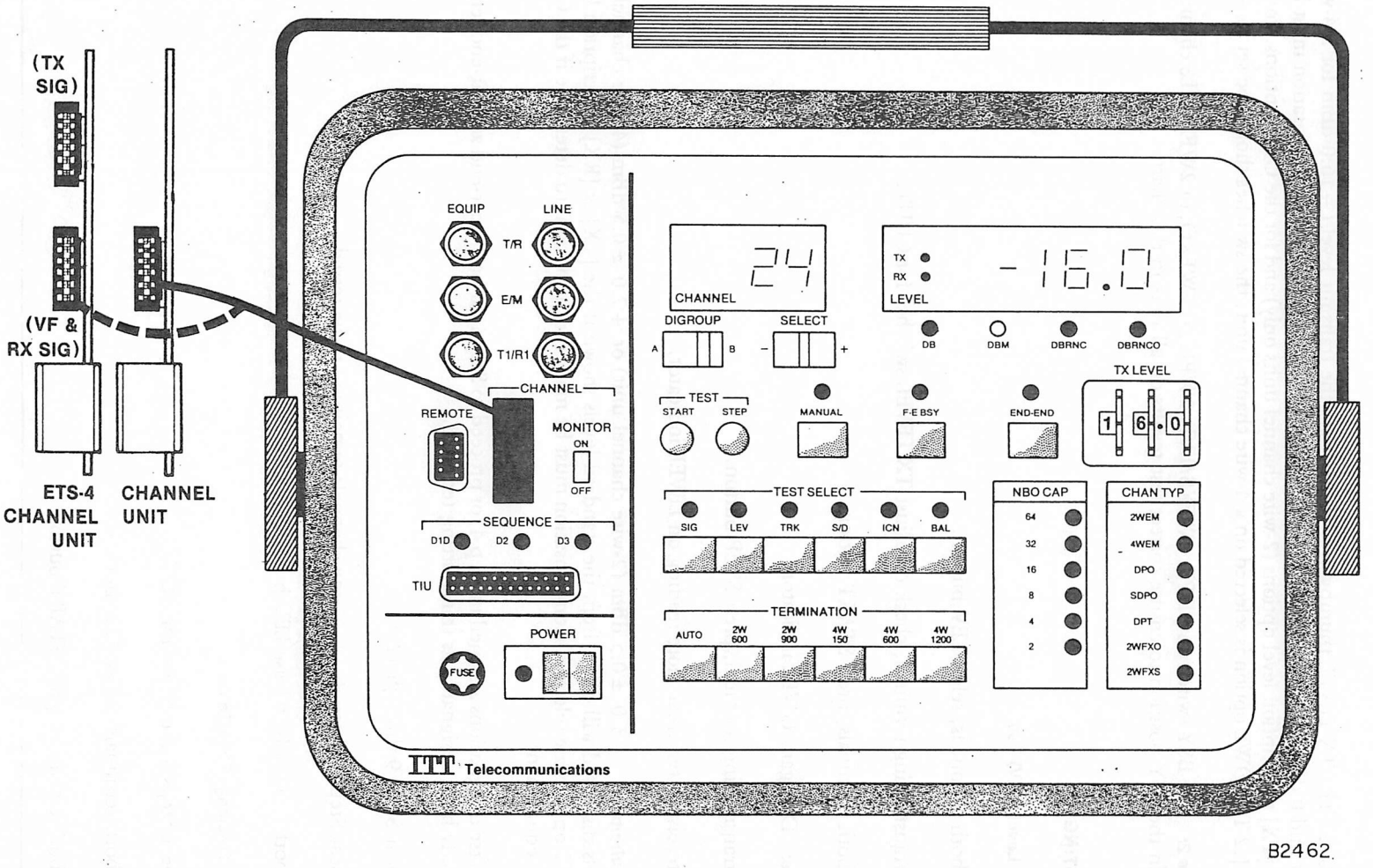

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Fig. 1—ATAU Test Connections

CHART 1 (Cont)

STEP	PROCEDURE

Note 1: The TX LEVEL thumbwheel switches set the transmit level (−16.0 dBm for a 4-wire channel unit and 0 dBm for a 2-wire channel unit). When setting the switches, compensation must be made for the [TX] prescription level options (2-wire channel units only) and for the OWL options. For example, if the [.2 TX] OWL option is selected on a 4-wire channel unit, the switches should be set to −16.2 dBm.

Note 2: The BSY switch on a DPT, 2WFXS/EVF, 2WPLAR, 2WFXO, or 2WFXO/LS channel unit must be in the BSY position to ensure correct test results on all tests in this chart.

TESTING

A. Level (LEV) Test

8 At both terminals, select LEV button.

9 At transmitting terminal, check or adjust TX LEVEL switches for CUUT.

10 At both terminals, press START button.

Note: Disregard LEVEL indicator.

11 At transmitting terminal, press STEP button.

12 At receiving terminal, note reading on LEVEL indicator.

Requirement: −3.0 ±0.5 dBm (2-wire channel unit) or +7.0 ±0.5 dBm (4-wire channel unit). The levels displayed will differ from the standard levels shown if the [TX] or [RX] prescription level and/or OWL options are selected. Compensation must be made for the options to determine if the CUUT meets the requirement.

13 Reverse designations assigned in Step 4, or proceed to Step 15 if both near-end and far-end terminals have already been designated as transmitting terminal.

14 Repeat Steps 9 through 12.

15 Repeat Steps 4 through 14 for any channels remaining to be tested.

16 At both terminals, release LEV button.

B. Tracking (TRK) Test

17 Repeat Steps 4 through 6 for CUUT.

18 At both terminals, select TRK button.

19 At both terminals, press START button.

CHART 1 (Cont)

STEP	PROCEDURE
20	At transmitting terminal, check or adjust TX LEVEL switches for CUUT.
21	At transmitting terminal, press STEP button.
	Note: This action causes the initial 0-dBm0 level to be transmitted.
22	At receiving terminal, note reading on LEVEL indicator.
	Requirement: As specified in Table C.
23	Repeat Steps 21 and 22 for the four remaining transmitted levels.
	Requirement: As specified in Table C.

TABLE C

TRACKING TEST REQUIREMENTS

2-WIRE		4-WIRE	
TRANSMIT LEVEL (dBm)*	RECEIVE LEVEL (dBm)*	TRANSMIT LEVEL (dBm)*	RECEIVE LEVEL (dBm)*
0.0	−3.0 ±0.5	−16.0	+7.0 ±0.5
−10.0	−13.0 ±0.5	−26.0	−3.0 ±0.5
−20.0	−23.0 ±0.5	−36.0	−13.0 ±0.5
−30.0	−33.0 ±0.5	−46.0	−23.0 ±0.5
−40.0	−43.0 ±1.0	−56.0	−33.0 ±1.0

*For nominal factory-set channel unit levels per Table A.

24	Reverse designations assigned in Step 17, or proceed to Step 26 if both near-end and far-end terminals have already been designated as transmitting terminal.
25	Repeat Steps 20 through 23.
26	Repeat Steps 17 through 25 for any channels remaining to be tested.
27	At both terminals, release TRK button.
	C. Signal-to-Distortion (S/D) Test
28	Repeat Steps 4 through 6 for CUUT.
29	At both terminals, select S/D button.
30	At both terminals, press START button.

CHART 1 (Cont)

STEP	PROCEDURE

31 At transmitting terminal, check or adjust TX LEVEL switches for CUUT.

32 At transmitting terminal, press STEP button.

Note: This action causes the initial 0-dBm0 level to be transmitted.

33 At receiving terminal, note reading on LEVEL indicator.

Requirement: As specified in Table D.

34 Repeat Steps 32 and 33 for the four remaining transmitted levels.

Requirement: As specified in Table D.

TABLE D

SIGNAL-TO-DISTORTION TEST REQUIREMENTS

TRANSMIT LEVEL (0 dBm)		MIN. S/D RATIO (dB)
2-WIRE	4-WIRE	
0.0	− 16.0	33.0
− 10.0	− 26.0	33.0
− 20.0	− 36.0	33.0
− 30.0	− 46.0	33.0
− 40.0	− 56.0	27.0

35 Reverse designations assigned in Step 28, or proceed to Step 37 if both near-end and far-end terminals have already been designated as transmitting terminal.

36 Repeat Steps 31 through 34.

37 Repeat Steps 28 through 36 for any channels remaining to be tested.

38 At both terminals, release S/D button.

D. Idle Channel Noise (ICN) Test

39 Repeat Steps 4 through 6 for CUUT.

40 At both terminals, select ICN button.

41 At both terminals, press START button.

42 At both terminals, note reading on LEVEL indicator.

Requirement: 20 dBrnc maximum (2-wire channel unit) or 30 dBrnc maximum (4-wire channel unit). This requirement is based on nominal factory-set levels per Table A.

CHART 1 (Cont)

STEP	PROCEDURE

43 Repeat Steps 39 through 42 for any channels remaining to be tested.

E. Crosstalk Test

Note: In the D448 multiplex terminal, crosstalk has been reduced from an electrical (common equipment characteristic) plus physical source to a physical source only.

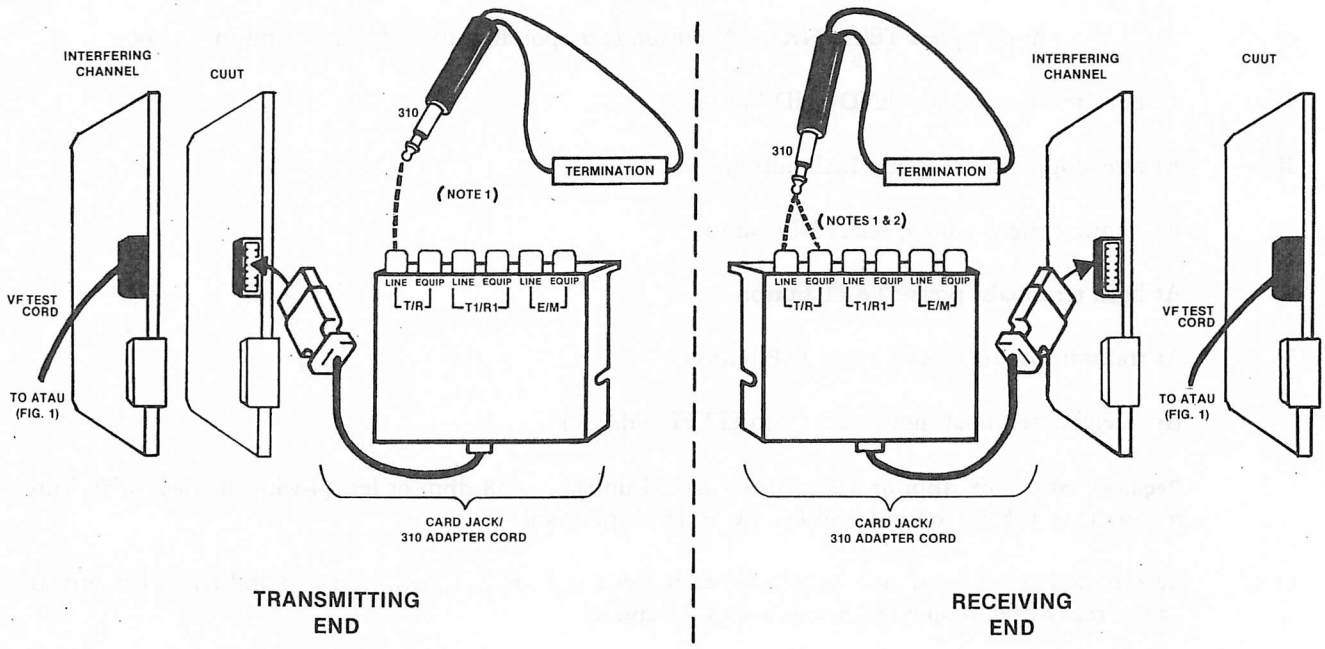
CAUTION: CUUT and adjacent channel(s) must be idle (associated trunk circuits busied).

Note: The most likely channel units responsible for crosstalk interference are those physically adjacent to CUUT.

44 Designate near-end terminal as transmitting terminal and far-end terminal as receiving terminal.

45 At both terminals, make test connections as shown in Fig. 2.

Note: The card jack/310 adapter cord (ITT Part No. 600397-540-003), which is used in this test, is shown in Fig. 3.



NOTES:
1. INTERFERING CHANNEL (RECEIVING END) MUST HAVE INTERFACING TRANSMITTING CU BOTH WITH TERMINATIONS INDICATED IN TABLE E.
2. FOR 2-WIRE CU. USE T/R. FOR 4-WIRE CU. USE T1/R1.

Fig. 2—Crosstalk Test Setup

CHART 1 (Cont)

STEP	PROCEDURE

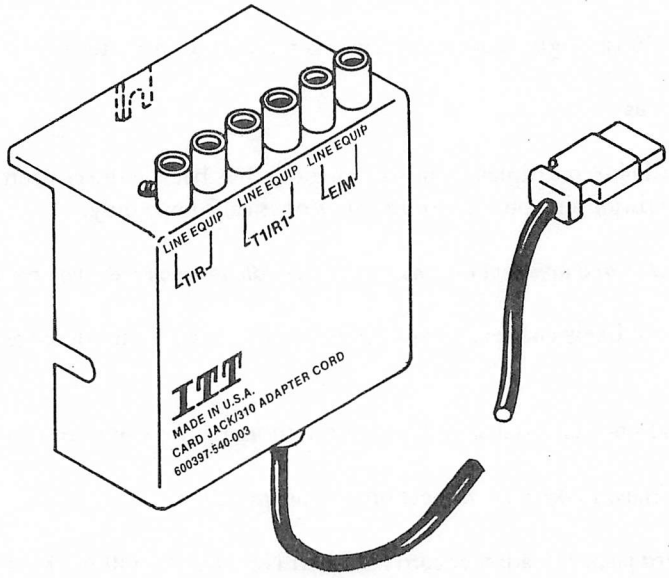


Fig. 3—Card Jack/310 Adapter Cord

46 At both terminals, press TERMINATION button corresponding to CUUT type and impedance.

47 At both terminals, select END-END button.

48 At receiving terminal, select BAL button.

49 At transmitting terminal, select LEV button.

50 At both terminals, press START button.

51 At transmitting terminal, press STEP button.

52 At receiving terminal, note reading on LEVEL indicator.

Requirement: – 68 dBm or less (2-wire channel unit) or – 58 dBm or less (4-wire channel unit). This requirement is based on nominal factory-set levels per Table A.

53 Reverse designations assigned in Step 44, or proceed to Step 55 if both near-end and far-end terminals have already been designated as transmitting terminal.

54 Repeat Steps 45 through 52.

55 Repeat Steps 44 through 54 for any channels remaining to be tested.

56 Remove all test connections, place POWER switch in off position, and disconnect power cord from outlet and ATAU.

CHART 2

END-TO-END TESTING USING STANDARD TEST EQUIPMENT

APPARATUS (REQUIRED AT EACH END):

1—Transmission test set (Northeast TTS-44, Telecommunications Technology TTI-1122, or equivalent)

2—Card jack/310 adapter cord (ITT Part No. 600397-540-003)

Terminations as indicated by Table E

STEP	PROCEDURE

Note 1: This Chart provides procedures for performing end-to-end testing when the ATAU is not available. The procedures in this chart use standard (customer-supplied) test equipment. Due to the numerous types of test equipment available, ITT makes no attempt to inform the user of specific test equipment control settings or interconnection. Detailed information on specific pieces of test equipment should be obtained from the manufacturer's operating manual.

Note 2: Card jack/310 adapter cord (ITT Part No. 600397-540-003), which is used in these tests, is shown in Fig. 3. For clarity, a simplified representation of the cord is used in the test setup figures.

Note 3: The BSY switch on a DPT, 2WFXS/EVF, 2WPLAR, 2WFXO, or 2WFXO/LS channel unit must be in the BSY position to ensure correct test results on all tests in this Chart.

Note 4: Table E lists the impedances of the D448 channel units so that the test equipment may be set to the proper input and output impedances and so that proper terminations may be selected when required.

Note 5: ETS-4 channel unit has two splitting card jacks. The lower jack, J2, must be used for VF and RX SIG access by the ATAU.

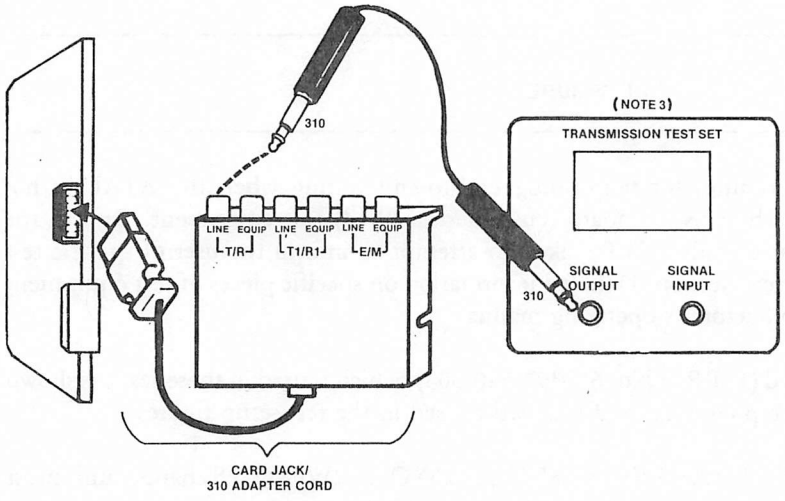
TABLE E

CHANNEL UNIT IMPEDANCES

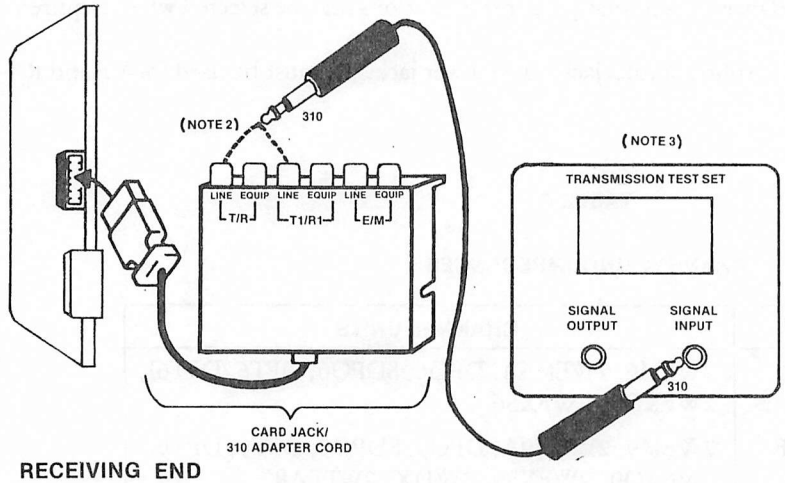
IMPEDANCE	CHANNEL UNITS
600 ohms + 2.16 uF	2WEM6, 2WEM6A, DPO6, SDPO6, DPT6, DPT6I, 2WFXO6, 2WFXS6
900 ohms + 2.16 uF	2WEM9, 2WEM9A, DPO9, SDPO9, DPT9, DPT9I, 2WFXO9, 2WFXS9, 2WDX, 2WPLAR
600 ohms	4WEM, 4WTO, 4WTO/SF, 4WPLR, 4WTDM, 4WEVF, 4WSF, ETS-4
150/600/1200 ohms (Impedance Determined by Option Selection)	4WETO, 4WFXO/VF, 4WFXO, 4WFXS/VF, 4WFXS, 4WDX/VF, 4WDX

CHART 2 (Cont)

STEP	PROCEDURE
1	Using Fig. 4 through 7 and the manufacturer's instructions for specific test equipment control settings and interconnections, perform the desired tests.
2	After testing, disconnect all test equipment.



TRANSMITTING END



RECEIVING END

VF LEVEL TEST

CU TYPE	TRANSMIT LEVEL	RECEIVE LEVEL
2-WIRE	0 ±0.25 dBm	−3 ±0.25 dBm
4-WIRE	−16 ±0.25 dBm	+7 ±0.25 dBm

TRACKING TEST

2-WIRE CU		4-WIRE CU	
TRANSMIT LEVEL (dBm)	RECEIVE LEVEL (dBm)	TRANSMIT LEVEL (dBm)	RECEIVE LEVEL (dBm)
0.0	−3.0 ±0.5	−16.0	+7.0 ±0.5
−10.0	−13.0 ±0.5	−26.0	−3.0 ±0.5
−20.0	−23.0 ±0.5	−36.0	−13.0 ±0.5
−30.0	−33.0 ±0.5	−46.0	−23.0 ±0.5
−40.0	−43.0 ±1.0	−56.0	−33.0 ±1.0

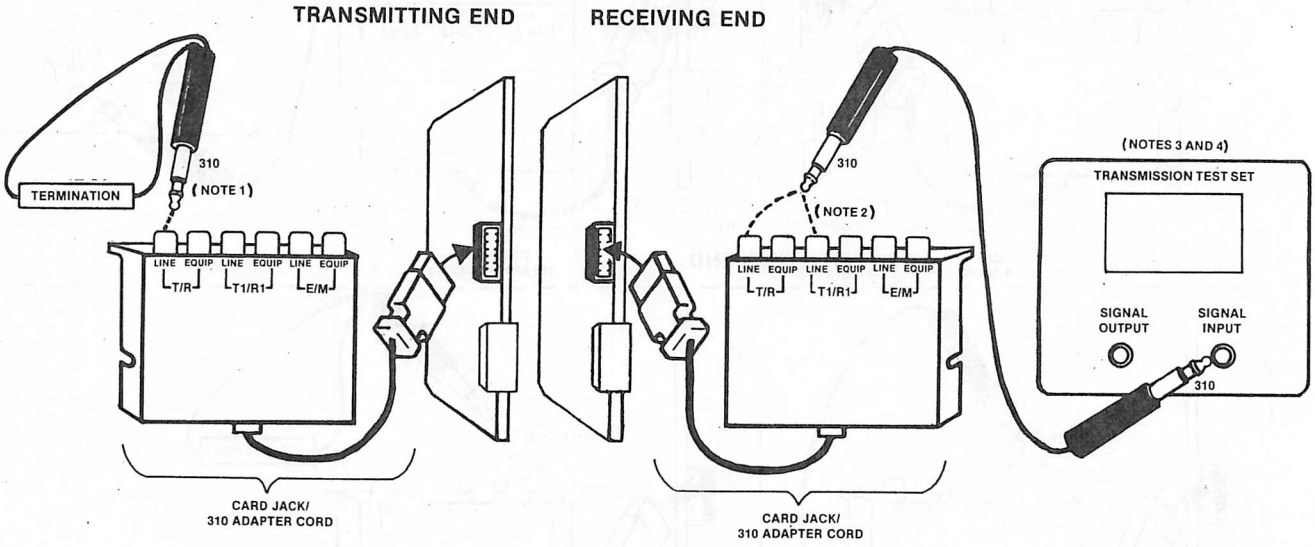
SIGNAL-TO-DISTORTION TEST

TRANSMIT LEVEL (dBm)		MAX. DISTORTION LEVEL (dBrnc)	
2-WIRE	4-WIRE	2-WIRE	4-WIRE
0.0	−16.0	54	64
−10.0	−26.0	44	54
−20.0	−36.0	34	44
−30.0	−46.0	24	34
−40.0	−56.0	20	30

NOTES:
1. REQUIREMENTS FOR ALL TESTS ARE BASED ON THE NOMINAL FACTORY-SET LEVELS PER TABLE A.
2. FOR 2-WIRE CU, USE T/R. FOR 4-WIRE CU, USE T1/R1.
3. SIGNAL INPUT AND OUTPUT CIRCUITRY IN THE TEST EQUIPMENT MUST MATCH THE IMPEDANCE OF THE CHANNEL UNITS UNDER TEST. SIGNAL INPUTS MUST BE MEASURED IN THE TERMINATED MODE. REFER TO TABLE E FOR CU IMPEDANCES.
4. THE RECOMMENDED TRANSMIT FREQUENCY FOR THESE TESTS IS 1004 TO 1020 Hz.
5. THE SIGNAL-TO-DISTORTION TEST REQUIRES A NOTCH FILTER CENTERED ON THE TRANSMITTING FREQUENCY, AND DISTORTION IS TO BE MEASURED USING A C-MESSAGE WEIGHTED FILTER.

Fig. 4—Typical Test Setup for VF Level, Tracking, and Signal-to-Distortion Tests

CHART 2 (Cont)



NOTES:

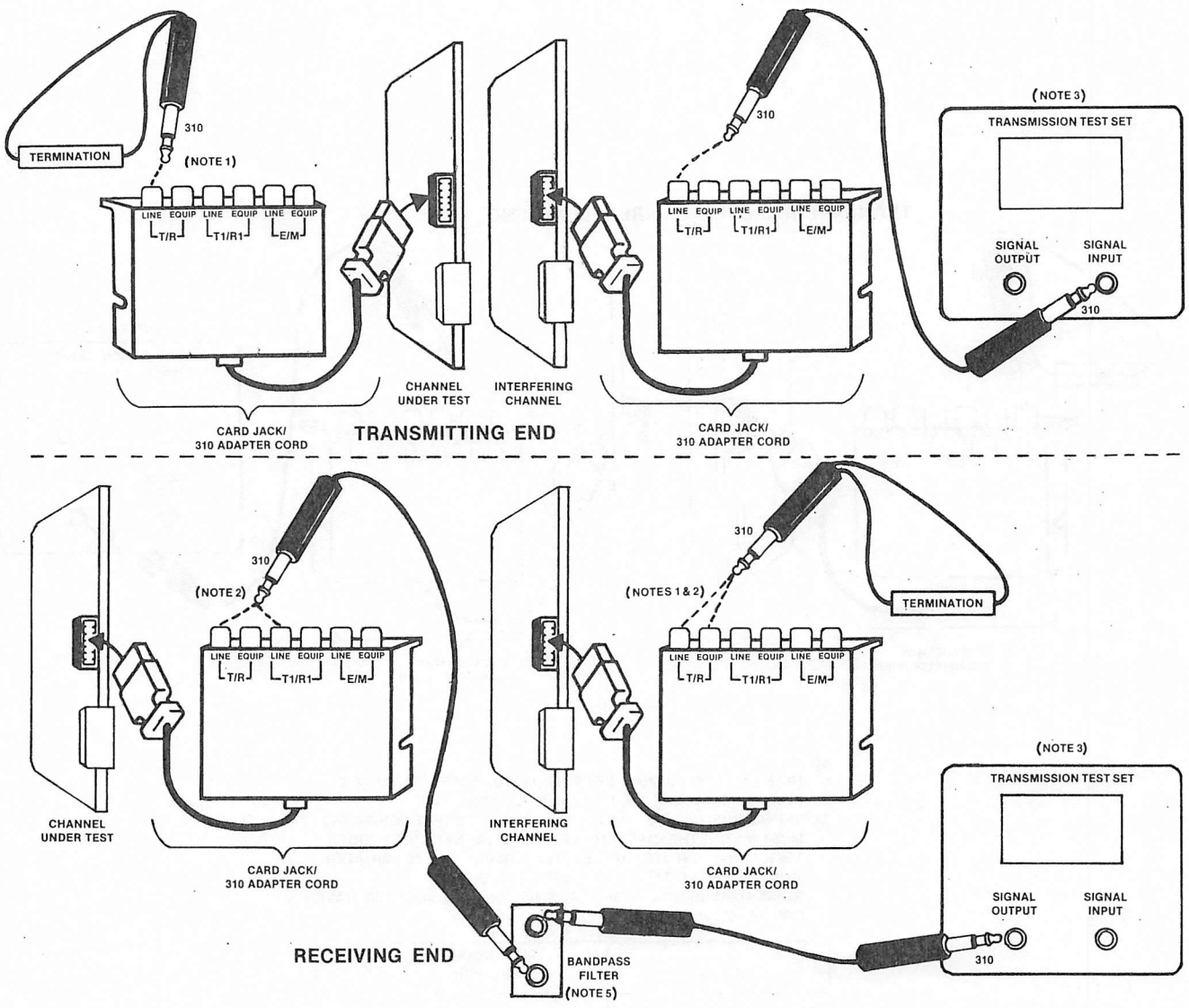
1. TRANSMITTING CU MUST BE TERMINATED. (REFER TO TABLE E.)
2. FOR 2-WIRE CU, USE T/R. FOR 4-WIRE CU, USE T1/R1.
3. SIGNAL INPUT AND OUTPUT CIRCUITRY IN THE TEST EQUIPMENT MUST MATCH THE IMPEDANCE OF THE CHANNEL UNITS UNDER TEST. SIGNAL INPUTS MUST BE MEASURED IN THE TERMINATED MODE. REFER TO TABLE E FOR CU IMPEDANCES.
4. NOISE MEASURING SET OR TRANSMISSION TEST SET MUST HAVE C-MESSAGE WEIGHTED FILTER.

CU TYPE	MAX. NOISE LEVEL (dBrnc)*
2-WIRE (NOMINAL RECEIVE VF LEVEL −3 dBm)	20
4-WIRE (NOMINAL RECEIVE VF LEVEL +7 dBm)	30

*BASED ON NOMINAL FACTORY-SET LEVELS PER TABLE A.

Fig. 5—Typical Idle Channel Noise Test Setup

CHART 2 (Cont)



NOTES:

1. BOTH INTERFERING CHANNEL (RECEIVE) AND CHANNEL UNDER TEST (TRANSMIT) MUST BE TERMINATED. (REFER TO TABLE E.)
2. FOR 2-WIRE CU, USE T/R. FOR 4-WIRE CU, USE T1/R1.
3. SIGNAL INPUT AND OUTPUT CIRCUITRY IN THE TEST EQUIPMENT MUST MATCH THE IMPEDANCE OF THE CHANNEL UNITS UNDER TEST. SIGNAL INPUTS MUST BE MEASURED IN THE TERMINATED MODE. REFER TO TABLE E FOR CU IMPEDANCES.
4. TRANSMITTING LEVEL —
   2-WIRE CU: 0.0 dBm
   4-WIRE CU: – 16.0 dBm
   RECOMMENDED TRANSMITTING FREQUENCY: 1004 TO 1020 Hz.
5. THE RECEIVE END MUST HAVE A NARROW BANDPASS FILTER CENTERED ON THE TRANSMITTING FREQUENCY.
6. IN THE D448 MULTIPLEX TERMINAL, CROSSTALK HAS BEEN REDUCED FROM AN ELECTRICAL (COMMON EQUIPMENT CHARACTERISTIC) PLUS PHYSICAL SOURCE TO PHYSICAL ONLY.

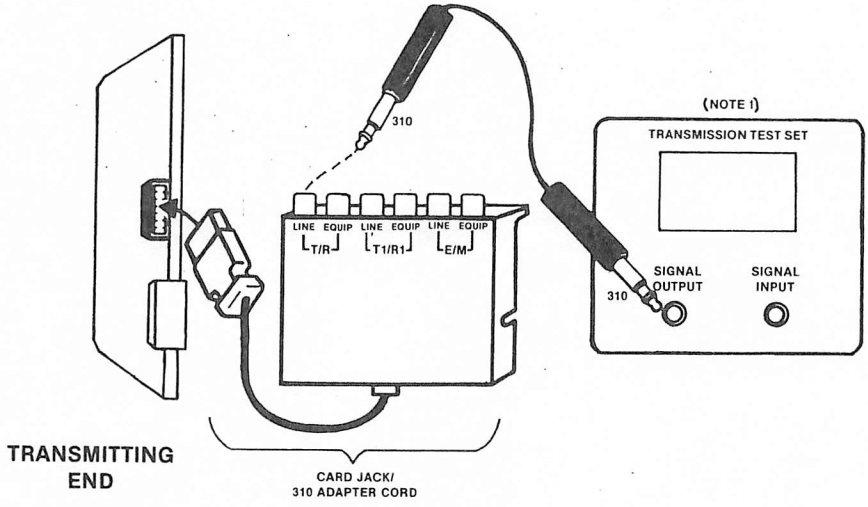
THIS OPTIONAL TEST NEED ONLY BE PERFORMED ON ONE CHANNEL PER DIGROUP. THE MOST LIKELY CHANNEL UNITS RESPONSIBLE FOR CROSSTALK INTERFERENCE ARE THOSE PHYSICALLY ADJACENT TO THE CHANNEL UNDER TEST.

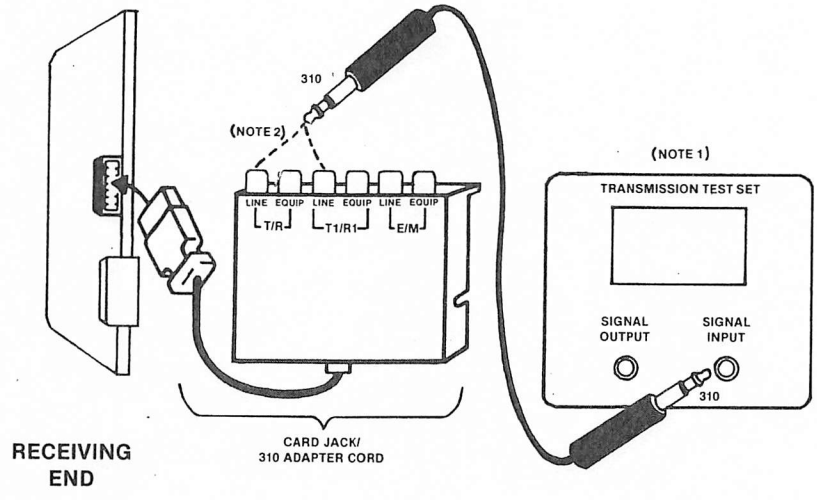
CU TYPE	INTERFERENCE LEVEL*
2-WIRE CU	– 68 dBm OR LESS (for example – 70)
4-WIRE CU	– 58 dBm OR LESS (for example – 60)

*BASED ON NOMINAL FACTORY-SET LEVELS PER TABLE A.

Fig. 6—Typical Crosstalk Test Setup

CHART 2 (Cont)





NOTES:
1. SIGNAL INPUT AND OUTPUT CIRCUITRY IN THE TEST EQUIPMENT MUST MATCH THE IMPEDANCE OF THE CHANNEL UNITS UNDER TEST. SIGNAL INPUTS MUST BE MEASURED IN THE TERMINATED MODE. REFER TO TABLE E FOR CU IMPEDANCES.
2. FOR 2-WIRE CU, USE T/R. FOR 4-WIRE CU, USE T1/R1.
3. TRANSMITTING LEVEL —
   2-WIRE CU: 0.0 dBm
   4-WIRE CU: −16.0 dBm
   OR OTHER DEPENDING ON PRESCRIPTION LEVEL SETTINGS.

INPUT FREQUENCY (Hz)	OUTPUT (dB)*		
	4-WIRE	2-WIRE 900 OHMS	2-WIRE 600 OHMS
300 to 600 300 to 3000	— +0.3 to −0.3	— +0.5 to −1.0	+1.0 to −3.0 —
600 to 3000 3200 3400	— +0.15 to −1.5 0 to −3.0	— +0.25 to −1.5 0 to −3.0	+1.0 to −1.0 +1.0 to −1.5 +1.0 to −3.0

*Referenced to 1020 Hz.

Fig. 7—Typical Frequency Response Test Setup